

(2) Retain these records for five years.

#### APPENDIX A TO PART 227—NOISE EXPOSURE COMPUTATION

This appendix is mandatory.

##### I. COMPUTATION OF EMPLOYEE NOISE EXPOSURE

A. Noise dose is computed using Table A-1 as follows:

1. When the sound level, L, is constant over the entire work day, the noise dose, D, in percent, is given by:  $D = 100 C/T$ , where C is the total length of the work day, in hours, and T is the duration permitted corresponding to the measured sound level, L, as given in Table A-1.

2. When the work day noise exposure is composed of two or more periods of noise at different levels, the total noise dose over the work day is given by:

$D = 100 (C_1/T_1 + C_2/T_2 + \dots + C_n/T_n)$ , where Cn indicates the total time of exposure at a specific noise level, and Tn indicates the duration permitted for that level as given by Table A-1.

B. The eight-hour TWA in dB may be computed from the dose, in percent, by means of the formula:  $TWA = 16.61 \log_{10} (D/100) + 90$ . For an eight-hour work day with the noise level constant over the entire day, the TWA is equal to the measured sound level.

C. Exposure to impulsive or impact noise should not exceed 140 dB peak sound pressure level.

D. Any time that an employee spends deadheading shall be included in the calculation of the noise dose.

E. A table relating dose and TWA is given in Section II of this Appendix.

TABLE A-1<sup>1</sup>

A-weighted sound level, L (decibel)	Duration permitted T (hour)
80 .....	32
81 .....	27.9
82 .....	24.3
83 .....	21.1
84 .....	18.4
85 .....	16
86 .....	13.9
87 .....	12.1
88 .....	10.6
89 .....	9.2
90 .....	8
91 .....	7.0
92 .....	6.1
93 .....	5.3
94 .....	4.6
95 .....	4
96 .....	3.5
97 .....	3.0
98 .....	2.6
99 .....	2.3

TABLE A-1<sup>1</sup>—Continued

A-weighted sound level, L (decibel)	Duration permitted T (hour)
100 .....	2
101 .....	1.7
102 .....	1.5
103 .....	1.3
104 .....	1.1
105 .....	1
106 .....	0.87
107 .....	0.76
108 .....	0.66
109 .....	0.57
110 .....	0.5
111 .....	0.44
112 .....	0.38
113 .....	0.33
114 .....	0.29
115 .....	0.25
116 .....	0.22
117 .....	0.19
118 .....	0.16
119 .....	0.14
120 .....	0.125
121 .....	0.11
122 .....	0.095
123 .....	0.082
124 .....	0.072
125 .....	0.063
126 .....	0.054
127 .....	0.047
128 .....	0.041
129 .....	0.036
130 .....	0.031
140 .....	0.078

<sup>1</sup> Numbers above 115 dB(A) are italicized to indicate that they are noise levels that are not permitted. The italicized numbers are included only because they are sometimes necessary for the computation of noise dose.

In the above table the duration permitted, T, is computed by

$$T = \frac{8}{2^{(L-90)/5}}$$

where L is the measured A-weighted sound level.

#### II. CONVERSION BETWEEN “DOSE” AND “8-HOUR TIME-WEIGHTED AVERAGE” SOUND LEVEL

A. Compliance with subpart B of part 227 is determined by the amount of exposure to noise in the workplace. The amount of such exposure is usually measured with a dosimeter which gives a readout in terms of “dose.” In order to better understand the requirements of the regulation, dosimeter readings can be converted to an “8-hour TWA.”

B. In order to convert the reading of a dosimeter into TWA, see Table A-2, below. This table applies to dosimeters that are set by the manufacturer to calculate dose or percent exposure according to the relationships in Table A-1. So, for example, a dose of 91 percent over an eight-hour day results in a

**Pt. 227, App. A**

**49 CFR Ch. II (10–1–12 Edition)**

TWA of 89.3 dB, and a dose of 50 percent corresponds to a TWA of 85 dB.

C. If the dose as read on the dosimeter is less than or greater than the values found in Table A-2, the TWA may be calculated by using the formula:  $TWA = 16.61 \log_{10} (D/100) + 90$  where TWA = 8-hour time-weighted average sound level and D = accumulated dose in percent exposure.

**TABLE A-2—CONVERSION FROM “PERCENT NOISE EXPOSURE” OR “DOSE” TO “8-HOUR TIME-WEIGHTED AVERAGE SOUND LEVEL” (TWA)**

Dose or percent noise exposure	TWA
10 .....	73.4
15 .....	76.3
20 .....	78.4
25 .....	80.0
30 .....	81.3
35 .....	82.4
40 .....	83.4
45 .....	84.2
50 .....	85.0
55 .....	85.7
60 .....	86.3
65 .....	86.9
70 .....	87.4
75 .....	87.9
80 .....	88.4
81 .....	88.5
82 .....	88.6
83 .....	88.7
84 .....	88.7
85 .....	88.8
86 .....	88.9
87 .....	89.0
88 .....	89.1
89 .....	89.2
90 .....	89.2
91 .....	89.3
92 .....	89.4
93 .....	89.5
94 .....	89.6
95 .....	89.6
96 .....	89.7
97 .....	89.8
98 .....	89.9
99 .....	89.9
100 .....	90.0
101 .....	90.1
102 .....	90.1
103 .....	90.2
104 .....	90.3
105 .....	90.4
106 .....	90.4
107 .....	90.5
108 .....	90.6
109 .....	90.6
110 .....	90.7
111 .....	90.8
112 .....	90.8
113 .....	90.9
114 .....	90.9
115 .....	91.1
116 .....	91.1
117 .....	91.1
118 .....	91.2
119 .....	91.3
120 .....	91.3
125 .....	91.6

**TABLE A-2—CONVERSION FROM “PERCENT NOISE EXPOSURE” OR “DOSE” TO “8-HOUR TIME-WEIGHTED AVERAGE SOUND LEVEL” (TWA)—Continued**

Dose or percent noise exposure	TWA
130 .....	91.9
135 .....	92.2
140 .....	92.4
145 .....	92.7
150 .....	92.9
155 .....	93.2
160 .....	93.4
165 .....	93.6
170 .....	93.8
175 .....	94.0
180 .....	94.2
185 .....	94.4
190 .....	94.6
195 .....	94.8
200 .....	95.0
210 .....	95.4
220 .....	95.7
230 .....	96.0
240 .....	96.3
250 .....	96.6
260 .....	96.9
270 .....	97.2
280 .....	97.4
290 .....	97.7
300 .....	97.9
310 .....	98.2
320 .....	98.4
330 .....	98.6
340 .....	98.8
350 .....	99.0
360 .....	99.2
370 .....	99.4
380 .....	99.6
390 .....	99.8
400 .....	100.0
410 .....	100.2
420 .....	100.4
430 .....	100.5
440 .....	100.7
450 .....	100.8
460 .....	101.0
470 .....	101.2
480 .....	101.3
490 .....	101.5
500 .....	101.6
510 .....	101.8
520 .....	101.9
530 .....	102.0
540 .....	102.2
550 .....	102.3
560 .....	102.4
570 .....	102.6
580 .....	102.7
590 .....	102.8
600 .....	102.9
610 .....	103.0
620 .....	103.2
630 .....	103.3
640 .....	103.4
650 .....	103.5
660 .....	103.6
670 .....	103.7
680 .....	103.8
690 .....	103.9
700 .....	104.0
710 .....	104.1
720 .....	104.2

TABLE A-2—CONVERSION FROM “PERCENT NOISE EXPOSURE” OR “DOSE” TO “8-HOUR TIME-WEIGHTED AVERAGE SOUND LEVEL” (TWA)—Continued

Dose or percent noise exposure	TWA
730 .....	104.3
740 .....	104.4
750 .....	104.5
760 .....	104.6
770 .....	104.7
780 .....	104.8
790 .....	104.9
800 .....	105.0
810 .....	105.1
820 .....	105.2
830 .....	105.3
840 .....	105.4
850 .....	105.4
860 .....	105.5
870 .....	105.6
880 .....	105.7
890 .....	105.8
900 .....	105.8
910 .....	105.9
920 .....	106.0
930 .....	106.1
940 .....	106.2
950 .....	106.2
960 .....	106.3
970 .....	106.4
980 .....	106.5
990 .....	106.5
999 .....	106.6

#### APPENDIX B TO PART 227—METHODS FOR ESTIMATING THE ADEQUACY OF HEARING PROTECTOR ATTENUATION

This appendix is mandatory.

Employers must select one of the following three methods by which to estimate the adequacy of hearing protector attenuation.

##### I. DERATE BY TYPE

Derate the hearing protector attenuation by type using the following requirements:

A. Subtract 7 dB from the published Noise Reduction Rating (NRR).

B. Reduce the resulting amount by:

1. 20% for earmuffs,
2. 40% for form-able earplugs, or
3. 60% for all other earplugs.

C. Subtract the remaining amount from the A-weighted TWA. You will have the estimated A-weighted TWA for that hearing protector.

##### II. METHOD B FROM ANSI S12.6-1997 (REAFFIRMED 2002)

Use Method B, which is found in ANSI S12.6-1997 (Reaffirmed 2002) “Methods for Measuring the Real-Ear Attenuation of Hearing Protectors.” The Director of the Federal Register approves the incorporation by reference of this standard in accordance with 5 U.S.C. 552(a) and 1 CFR part 51. You

may obtain a copy of the incorporated standard from the American National Standards Institute at 1819 L Street, NW., Washington, DC 20036, or <http://www.ansi.org>. You may inspect a copy of the incorporated standard at the Federal Railroad Administration, Docket Room, 1200 New Jersey Avenue, SE., Washington, DC 20590, or at the National Archives and Records Administration (NARA). For information on the availability of this material at NARA, call 202-741-6030, or go to [http://www.archives.gov/federal\\_register/code\\_of\\_federal\\_regulations/ibr\\_locations.html](http://www.archives.gov/federal_register/code_of_federal_regulations/ibr_locations.html).

##### III. OBJECTIVE MEASUREMENT

Use actual measurements of the level of noise exposure (as an A-weighted SLOW response dose) inside the hearing protector when the employee wears the hearing protector in the actual work environment.

[71 FR 63123, Oct. 27, 2006, as amended at 74 FR 25173, May 27, 2009]

#### APPENDIX C TO PART 227—AUDIOMETRIC BASELINE REVISION

This appendix is mandatory beginning on February 26, 2009.

##### I. GENERAL

A. A professional reviewer (audiologist, otolaryngologist, or physician) shall use these procedures when revising baseline audiograms.

B. Although these procedures can be programmed by a computer to identify records for potential revision, the final decision for revision rests with a human being. Because the goal of the guidelines is to foster consistency among different professional reviewers, human override of the guidelines must be justified by specific concrete reasons.

C. These procedures do not apply to: The identification of standard threshold shifts (STS) other than an FRA STS<sup>1</sup> or to the calculation of the 25-dB average shifts that are reportable on the Form FRA F 6180.55a.

D. Initially, the baseline is the latest audiogram obtained before entry into the hearing conservation program. If no appropriate pre-entry audiogram exists, the baseline is the first audiogram obtained after entry into the hearing conservation program. Each subsequent audiogram is reviewed to detect improvement in the average (average of thresholds at 2, 3, and 4 kHz) and to detect an FRA STS. The two ears are examined separately and independently for improvement and for worsening. If one ear meets the criteria for revision of baseline,

<sup>1</sup>OSHA and FRA use the same definition for Standard Threshold Shift (STS). FRA's definition is located in § 227.5. OSHA's definition is located in 29 CFR 1910.95(g)(10)(i).